Having thus described the preferred embodiments, the invention is now claimed to be:

1. A magnetic resonance cardiac imaging method for imaging a heart, the method comprising:

applying a data acquisition sequence including:

a first preparation sequence block,

a first imaging sequence block having at least one readout interval that collects first data,

a second preparation sequence block, and

a second imaging sequence block having at least one readout interval that collects second data,

the data acquisition sequence occupying an acquisition time interval which is less than a cardiac cycle interval of the heart.

2. The method as set forth in claim **1**, further including:

monitoring an electrocardiographic signal associated with the heart for a first trigger event; and

responsive to the first trigger event, initiating the applying of the data acquisition sequence.

3. The method as set forth in claim **2**, further including:

providing a gating delay interval between the first trigger event and the start of the data acquisition sequence, the gating delay interval plus a time of the data acquisition sequence together being less than the cardiac cycle interval.

4. The method as set forth in claim **3**, further including:

providing a trigger window interval trailing the data acquisition sequence; and

terminating the trigger window interval responsive to detection of a second trigger event.

5. The method as set forth in claim **1**, wherein:

the first preparation sequence block performs a first magnetization preparation affecting at least a portion of the heart; and

the second preparation sequence block performs a second magnetization preparation affecting at least a portion of the heart, wherein the second magnetization preparation is different from the first magnetization preparation.

6. The method as set forth in claim **1**, wherein:

the first imaging sequence block effectuates data acquisition having a first image contrast type; and

the second imaging sequence block effectuates data acquisition having a second image contrast type that is different from the first image contrast type.

7. The method as set forth in claim **1**, wherein at least one of the first preparation sequence block and the second preparation sequence block performs at least one of spatial modulation of magnetization (SPAMM) and complementary spatial modulation of magnetization (CSPAMM) tagging of at least a portion of the cardiac muscle.

8. The method as set forth in claim **1**, wherein one of:

the first preparation sequence block combined with the first imaging sequence block, and

the second preparation sequence block combined with the second imaging sequence block,

effectuates acquisition of imaging data with one of superimposed spatial modulation of magnetization (SPAMM) tagging and superimposed complementary spatial modulation

of magnetization (CSPAMM) tagging.

9. The method as set forth in claim **8**, wherein the other of:

the first preparation sequence block combined with the first imaging sequence block, and

the second preparation sequence block combined with the second imaging sequence block,

characterizes blood perfusion or late enhancement.

10. The method as set forth in claim **1**, further including:

measuring the cardiac cycle interval using the monitored electrocardiographic signal;

timing the application of the data acquisition sequence to the cardiac cycle based on the measured cardiac cycle interval; and

temporally registering at least one of first data and second data with the electrocardiographic signal using retrospective gating.

11. The method as set forth in claim **1**, wherein:

the first preparation sequence block applies a first spatial modulation of magnetization tagging; and

the second preparation sequence block applies a second spatial modulation of magnetization tagging.

12. The method as set forth in claim **11**, further including:

monitoring an electrocardiographic signal associated with the heart for a first trigger event;

responsive to the first trigger event, initiating the applying of the data acquisition sequence;

monitoring an electrocardiographic signal associated with the heart for a second trigger event temporally located at least one cardiac cycle interval distant from

the first trigger event;

responsive to the second trigger event, applying a complementary data acquisition sequence including:

a third preparation sequence block complementary to the first preparation sequence block,

a third imaging sequence block having at least one readout interval that collects third data,

a fourth preparation sequence block complementary to the second preparation sequence block, and

a fourth imaging sequence block having at least one readout interval that collects fourth data,

the complementary data acquisition sequence occupying a complementary acquisition time interval which is less than the cardiac cycle interval of the heart.

13. The method as set forth in claim **12**, further including:

repeating the data acquisition sequence and the complementary data acquisition sequence over a plurality of cardiac cycle intervals to form first, second, third, and fourth segmented k-space data sets;

generating a first CSPAMM segmented k-space data set by subtractively combining the first segmented k-space data set and the third segmented k-space data set;

generating a second CSPAMM segmented k-space data set by subtractively combining the second segmented k-space data and the fourth segmented k-space data set; and

reconstructing first and second CSPAMM segmented k-space data sets to generate first and second CSPAMM image representations each including at least one image.

14. The method as set forth in claim **12**, further including:

repeating the data acquisition sequence and the complementary data acquisition sequence over a plurality of cardiac cycle intervals to form first, second, third, and fourth segmented k-space data sets;

combining the first segmented k-space data set with the third segmented k-space data set to generate a first complementary spatial modulation of magnetization (CSPAMM) image sequence; and

combining the second segmented k-space data set with the fourth segmented k-space data set to generate a second CSPAMM image sequence.

15. The method as set forth in claim **1**, wherein:

the first preparation sequence block performs a SPAMM tagging of at least a portion of the cardiac muscle; and

the second imaging sequence block acquires one of perfusion imaging data and late enhancement imaging data.

16. The method as set forth in claim **15**, further including:

repeating the applying of the data acquisition sequence over a plurality of cardiac cycle intervals;

combining the first data acquired over the plurality of cardiac cycle intervals to form first segmented data corresponding to at least one segmented SPAMM or CSPAMM image;

combining the second data acquired over the plurality of cardiac cycle intervals to form second image sequence data corresponding to a plurality of images having perfusion or late enhancement contrast;

reconstructing first segmented data to form at least one SPAMM or CSPAMM image representation; and

reconstructing second image sequence data to form a plurality of images having perfusion or late enhancement contrast.

17. A method for reducing the specific absorption

ratio (SAR) received by a patient during magnetic resonance imaging of a cardiac cycle interval, the method comprising:

applying a first preparatory sequence block to the patient at a first point in the cardiac cycle interval;

acquiring first image data responsive to the first preparatory sequence block;

applying a second preparatory sequence block to the patient at a second point in the cardiac cycle interval; and

acquiring second image data responsive to the second preparatory sequence block.

18. The method as set forth in claim **17**, wherein the total time interval over which the applying of the first preparatory sequence block, the acquiring of first image data, the applying of the second preparatory sequence block, and the acquiring of second image data occur is less than the cardiac cycle interval.

19. An apparatus for acquiring image data associated with cardiac cycling of a heart, the apparatus comprising:

a magnetic resonance imaging (MRI) scanner arranged to interact with at least a portion of the heart;

an electrocardiograph that monitors the cardiac cycling;

an imaging sequence processor communicating with the MRI scanner and the electrocardiograph to perform an MRI data acquisition sequence with timing coordinated by a signal from the electrocardiograph, the data acquisition sequence including:

a first preparatory sequence block that produces a first modification of heart magnetization,

a first imaging sequence block including at least one readout that produces first image data associated with the heart,

a second preparatory sequence block that produces a second modification of heart magnetization, and

a second imaging sequence block including at least one readout that produces second image data associated with the heart,

the data acquisition sequence occurring over an acquisition time interval which is smaller than a cardiac cycle interval; and

a reconstruction processor that reconstructs first and second image data to form a plurality of image representations of the heart which are associated with selected portions of the cardiac cycle.

20. The apparatus as set forth in claim **19**, wherein at least one of the first preparatory sequence block and the second preparatory sequence block produces a spatially modulated heart magnetization.

21. The apparatus as set forth in claim **19**, wherein the first preparatory sequence block and the second preparatory sequence block effectuate different modifications of the heart magnetization.

22. The apparatus as set forth in claim **19**, wherein:

the first preparatory sequence block and the first imaging sequence block cooperate to effectuate a first imaging contrast; and

the second preparatory sequence block and the second imaging sequence block cooperate to effect a second imaging contrast.

23. The apparatus as set forth in claim **22**, wherein the first imaging contrast is different from the second imaging contrast.

24. The apparatus as set forth in claim **19**, wherein

the data acquisition sequence further includes:

a third preparatory sequence block that produces a third modification of heart magnetization; and

a third imaging sequence block including at least one readout that produces third image data associated with the heart.